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(54) Antifreeze/coolant composition

(57) An antifreeze/coolant composition is disclosed, which can effectively inhibit corrosion of metals, particularly cast aluminum and cast iron, and can also inhibit cavitation damage to metals in an engine cooling system. The antifreeze/coolant composition comprises a

glycol as the chief ingredient, 0.1-0.5 % by weight of at least one ingredient selected from among hexanoic acid, heptanoic acid and their salts, and 0.1-0.5 % by weight of at least one ingredient selected from among alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts.

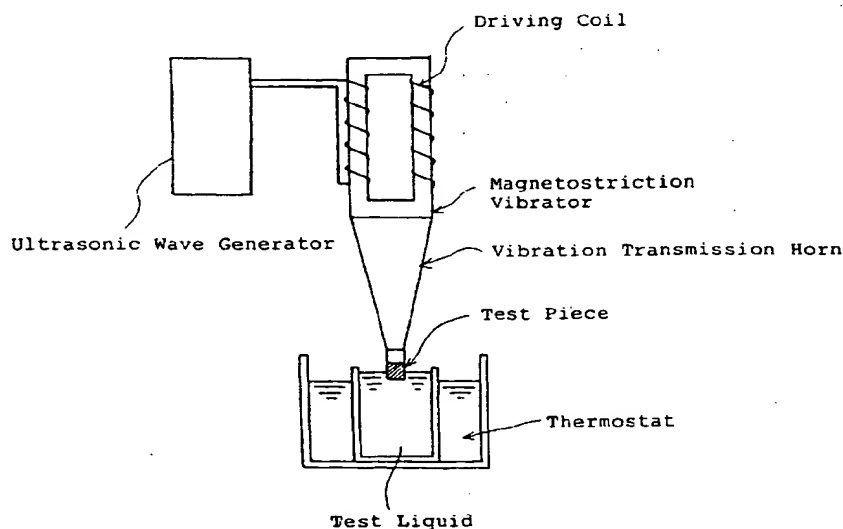


Fig. 1

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**Description****BACKGROUND OF THE INVENTION****Technical Field:**

This invention generally relates to an antifreeze/coolant composition. More particularly, this invention relates to an antifreeze/coolant composition which excels in corrosion inhibition of metals used in a cooling system for an engine, particularly cast aluminum and cast iron, as well as in inhibiting "cavitation" damage.

**Background Art:**

A cooling system for an internal-combustion engine generally uses various metals such as aluminum, cast aluminum, cast iron, steel, brass, solder and copper, which are subject to corrosion over time by water or moist air. In order to inhibit metal corrosion, a metal corrosion inhibition solution such as an antifreeze/coolant composition containing a metal corrosion inhibitor is generally blended in the cooling liquid or water in the cooling system.

An antifreeze/coolant composition as well as cooling water inherently contains some air dissolved therein, which will generate air bubbles or cavitation within the cooling system due chiefly to local fluidic pressure difference and/or vibrations generated through the cooling system. Metal portions, particularly iron parts, of the cooling system can be damaged or corroded by the bubbles, which is called "cavitation damage".

Conventionally, nitrite is blended in antifreeze/coolant compositions to inhibit generation of cavitation. It is assumed that nitrite blended in the antifreeze/coolant compositions provides a protection cover over the metal parts.

Nitrite however is known to produce nitrosamine, a carcinogenic substance, by chemical reaction with amine salts in the cooling liquid. Although use of nitrite in antifreeze/coolant compositions has given rise to controversy, no other effective and safe substitute to inhibit cavitation existed.

Accordingly, it is an object of the present invention to provide an antifreeze/coolant composition which effectively and safely inhibits both corrosion of metals, particularly cast aluminum and cast iron, and generation of cavitation in a cooling system.

**SUMMARY OF THE INVENTION**

The antifreeze/coolant composition of the present invention comprises a glycol as the chief ingredient, about 0.1-5.0 % by weight of at least one ingredient selected from the group consisting of hexanoic acid, heptanoic acid and their salts, and about 0.1-5.0 % by weight of at least one ingredient selected from the group consisting of alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts.

The antifreeze/coolant composition of the present invention may further comprise about 0.05-1.0 % by weight of at least one triazole. Optionally, the antifreeze/coolant composition of the present invention may be characterized in that no operative amount of amine salts or borates are included.

**BRIEF DESCRIPTION OF THE DRAWING**

FIG. 1 schematically shows an apparatus for studying the cavitation inhibitory property of compositions.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

The antifreeze/coolant composition of the present invention comprises a glycol as the main ingredient, such as ethylene glycol, propylene glycol, 1,3 butylene glycol, hexylene glycol, diethylene glycol or glycerin, among which ethylene glycol and propylene glycol are preferred for their chemical stability and low cost.

The composition further comprises at least one ingredient selected from among hexanoic acid, heptanoic acid and their salts and at least one ingredient selected from among alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts.

Here, hexanoic acid, heptanoic acid and their salts individually have an excellent aluminum and iron corrosion inhibitory property, and in cooperation with at least one ingredient selected from the group of alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts can excellently inhibit cavitation in a cooling system.

The salts of hexanoic acid and heptanoic acid may be their alkali metal salts, ammonium salts or amine salts, among which alkali metal salts are preferred. Preferred alkali metal salts are sodium salts and potassium salts. A plurality of these chemicals may be blended in the antifreeze/coolant composition of the present invention.

Such hexanoic acid, heptanoic acid and/or their salt or salts are blended in the antifreeze/coolant composition of the present invention in a total amount of about 0.1-5.0 % by weight. Less than that range will prove insufficient in

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prohibition of metal corrosion and cavitation while more than that range will merely be uneconomical.

Such alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts can individually inhibit metal corrosion, particularly aluminum and iron corrosion, as well as inhibit cavitation in a cooling system in cooperation with hexanoic acid, heptanoic acid and/or their salt or salts. In addition, they can individually inhibit precipitation with hard water minerals in the cooling liquid.

The alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl may be p-toluic acid, p-ethylbenzoic acid, p-propylbenzoic acid, p-isopropylbenzoic acid, p-butylbenzoic acid or p-tert butylbenzoic acid. The salts of alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl may be their alkali metal salts, ammonium salts or amine salts, among which alkali metal salts such as sodium salts and potassium salts are preferred. Such salts may be blended in a plurality.

The alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and/or their salts may be blended singly or in a plurality in the antifreeze/coolant composition of the present invention in a total amount of about 0.1-5.0 % by weight. Less than that range will be inefficient in inhibition of metal corrosion and cavitation and over that range will only be uneconomical.

A triazole or triazoles may be additionally blended, which effectively inhibit corrosion of metals, particularly copper and aluminum in a cooling system. Such triazoles may be benzotriazol, tolyltriazol, 4-phenyl-1,2,3-triazole, 2-naphthotriazol or 4-nitrobenzotriazol.

The triazole or triazoles may be blended in an amount of about 0.05-1.0 % by weight. Less than that range will be insufficient in inhibition of metal corrosion and more than that range will only be uneconomical.

The antifreeze/coolant composition of the present invention may optionally be characterized by the absence of certain ingredients, namely amine salts or borates. Generation of nitrosoamine in the cooling liquid will be prevented by the absence of amine salts, while the absence of borates will contribute to lessen corrosion of aluminum and aluminum alloys.

The antifreeze/coolant composition of the present invention may optionally and selectively comprise an antifoam and/or colorant, and/or a conventional metal corrosion inhibitor or inhibitors such as molybdate, tungstate, sulfate, nitrate, mercaptobenzothiazol, or their alkali metal salts.

Cavitation damage tests were conducted on Embodiments 1 and 2 and Comparisons 1-4 to study various antifreeze/coolant compositions in comparison using a magnetostriction vibrator schematically shown in Fig. 1. The compositions of Embodiments 1 and 2 were prepared according to the present invention and the compositions of Comparisons 1 to 4 were conventional compositions. Their respective ingredients are given in Table 1.

TABLE 1

Ingredient	Emb. 1	Emb. 2	Com. 1	Com. 2	Com. 3	Com. 4
Hexanoic Acid	3.00	-	-	-	-	-
Heptanoic Acid	-	3.00	-	-	3.00	-
Octanoic Acid	-	-	3.00	-	-	-
Nonanoic Acid	-	-	-	3.00	-	-
P-Toluic Acid	1.00	1.00	1.00	1.00	-	1.00
Tolyltriazol	0.30	0.30	0.30	0.30	0.30	0.30
Potassium Hydroxide	1.89	1.73	1.60	1.50	1.32	0.44
Ethylene Glycol	91.89	91.97	92.10	92.20	93.38	92.26
Water	2.00	2.00	2.00	2.00	2.00	2.00

("Emb." stands for Embodiment, and "Com." stands for Comparison)

The test conditions are given in Table 2.

TABLE 2

Item	Condition
Frequency	19 KHz
Amplitude	30 micro m
Test Pieces	FC200 (cast iron)
Shape/Size	Circular Disk/16mm D
Weight	About 14g
Concentration	20% JIS Water Dilution
Amount	50 ml
Temperature	50°C

TABLE 2 (continued)

Item	Condition
Depth	4 mm

The test results are given in Table 3.

TABLE 3

	Emb. 1	Emb. 2	Com. 1	Com. 2	Com. 3	Com. 4
Weight Reduction (mg)	41.60	44.00	81.50	192.70	122.20	232.30

As Table 3 clearly shows the weight reductions of Embodiments 1 and 2 were far smaller than those of Comparisons 1-4, showing that the compositions according to Embodiments 1 and 2 of the present invention are superior in cavitation inhibition to the conventional compositions according to Comparisons 1-4.

### Claims

1. An antifreeze/coolant composition comprising a glycol as the main ingredient, about 0.1-5.0 % by weight of at least one ingredient selected from the group consisting of hexanoic acid, heptanoic acid and their salts, and about 0.1-5.0 % by weight of at least one ingredient selected from the group consisting of alkylbenzoic acids having C<sub>1</sub>-C<sub>5</sub> alkyl and their salts.
2. An antifreeze/coolant composition of claim 1, further comprising about 0.05-1.0 % by weight of at least one triazole.
3. An antifreeze/coolant composition of claim 1 or 2 in the absence of an operative amount of amine salts or borates.

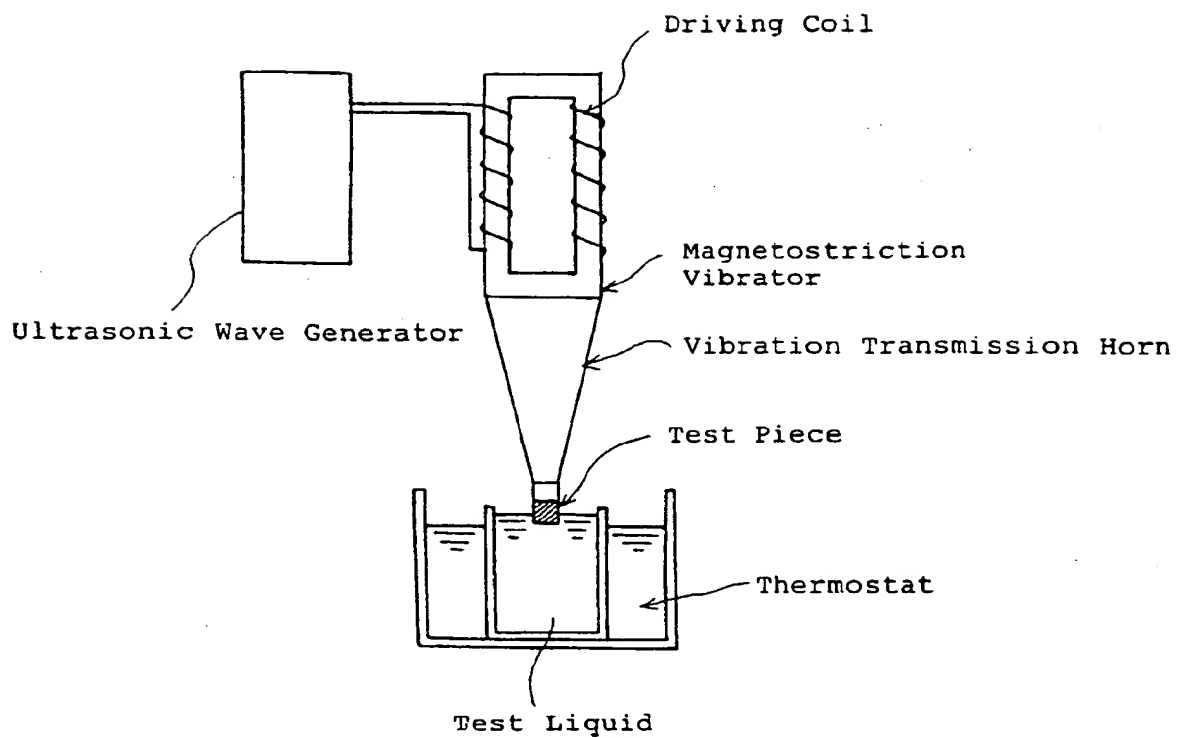


Fig. 1



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## EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 1677

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 251 480 A (TEXACO PETROLEUM) 7 January 1988 * the whole document *	1-3	C09K5/00
A	EP 0 564 721 A (TEXACO SERVICES EUROP LTD) 13 October 1993 * the whole document *	1-3	
A	EP 0 739 966 A (BP CHEM INT LTD ;BP CHEMICALS SNC (FR)) 30 October 1996 * page 2, line 54 - page 3, line 11 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			C09K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 June 1998	Examiner Puetz, C
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background C : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons S : member of the same patent family, corresponding document			

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